

Association Between Prepayment Systems and Emergency Medical Services Use Among Patients With Acute Chest Discomfort Syndrome

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Study objective: Cost concerns may inhibit emergency medical services (EMS) use. Novel tax-based and subscription prepayment programs indemnify patients against the cost of EMS treatment and transport. We determine whether the presence of (or enrollment in) prepayment plans increase EMS use among patients with acute chest discomfort, particularly those residing in low-income areas, those lacking private insurance, or both.

Methods: This study uses a subset of baseline data from the REACT trial, a multicenter, randomized controlled community trial designed, in part, to increase EMS use. The sample includes 860 consecutive noninstitutionalized patients (>30 years old) presenting with nontraumatic chest discomfort to hospital emergency departments in 4 Oregon/Washington communities. The association between prepayment systems and EMS use was analyzed using multivariable logistic regression.

Results: Overall EMS use was 52% (n=445). Among EMS users, 338 (75%) were subsequently admitted to the hospital and 110 (25%) were released from the ED. Prepayment was not associated with increased EMS use in the overall patient sample. However, patients residing in low-income census block groups (median annual income <\$30,000) were 2.6 times (95% confidence interval [CI] 1.4 to 4.8) more likely to use EMS when a prepayment system was available than when no system was present. No association was noted among higher-income block group residents. Among low-income block group residents lacking private insurance, prepayment systems were associated with 3.8 times (95% CI 1.2 to 13.4) greater EMS usage.

Conclusion: Economic considerations may affect EMS system utilization among underinsured and low-income patients experiencing a cardiac event. Prepayment systems may increase EMS utilization among these groups.

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INTRODUCTION

Potential benefits associated with the use of emergency medical services (EMS) among patients with symptoms of an acute myocardial infarction (AMI) include early diagnosis and treatment and the ability to manage life-threatening complications such as dysrhythmias.^{1,2} Despite these benefits, studies have shown that fewer than half of patients admitted for possible AMI use the 911 service of an EMS system.³

Reasons given by chest pain patients for choosing to self-transport rather than call 911 include believing their symptoms were not severe enough, not thinking of calling 911, and considering self-transportation to be quicker.^{4,5} Conversely, increasing age, the presence of other people during the cardiac event, medical history of angina, and increasing symptom severity have been associated with increased EMS usage.⁴ The influence of cost concerns on the decision to activate (or not activate) the EMS system during a supposed cardiac event has not been well established because currently available studies evaluating the "intent to use EMS" were conducted in regions served entirely by tax-based, prepaid EMS systems.³⁻⁷

Previous research indicates that financial factors do influence care-seeking behaviors. For example, among those admitted to the hospital for any condition, the uninsured were 9 times more likely to delay seeking care because of cost concerns than those with insurance. Those both poor and uninsured were most likely to delay seeking care.⁸

Financial liability associated with EMS use varies considerably across communities in the United States. In areas with no prepayment systems, patients may be billed from \$390 to \$900 for a cardiac-related ambulance transport.⁹ Locations with a tax-based prepayment system (publicly funded EMS) may not bill patients for their services. Also, hybrid EMS programs offer an optional "subscription" prepayment service in which members may be indemnified from the cost of EMS use by paying an annual membership fee.

This article examines the effect of tax-based and hybrid prepayment systems on EMS utilization among patients with chest pain in 4 cities in Oregon and Washington. It is

hypothesized that prepayment systems will be associated with greater EMS use, especially among low-income patients and those without private insurance.

MATERIALS AND METHODS

This study uses baseline data collected from October 22, 1995, to March 31, 1996, as part of the Rapid Early Action for Coronary Treatment (REACT) trial. REACT is a randomized, controlled, matched-pair community trial designed to test an intervention intended to reduce patient delay between the time of cardiac symptom onset to arrival at the hospital. The design and rationale for the REACT trial have been described in detail previously.^{10,11} Retrospective data abstracted from all area hospitals in one matched-pair set of communities from each state (Oregon and Washington) were included to assess the effect of prepayment systems on EMS utilization controlling for factors known to affect EMS use. This study was considered exempt from patient consent requirements by the Oregon Health Sciences University Institutional Review Board.

Data were collected from EDs in 2 community hospitals in 2 Oregon cities and 4 community hospital EDs in 2 Washington cities. Participating hospitals capture 90% of patients with acute coronary heart disease seeking emergency care in each community. The 4 cities were pair-matched within each state by size and demographics (Table 1). In one Oregon community, EMS are provided by a private company and the patient's insurance company is billed for the service. Patients are directly responsible for charges not covered by health insurance. The second Oregon community offers an optional prepayment scheme (nominal fee of \$35/year) that indemnifies the patient for any charges not covered by health insurance. In the Oregon community with an EMS prepayment system, 57% of study subjects subscribed to the prepayment system. The 2 Washington communities have tax-based EMS systems and do not bill patients for their services. Enhanced 911 coverage in each study community was absolute.

ED logs in each study hospital were monitored for patients presenting with chest pain, pressure, or tightness with or without discomfort. Patients were included in the sample if (1) there was no obvious trauma etiology explaining the complaint of chest discomfort, (2) the patient was older than 30 years and resided within ZIP code boundaries defining REACT communities, and (3) the patient was not institutionalized or transferred from another hospital.

Variables abstracted from ED records included mode of transport (ambulance versus other) and several demographic variables previously associated with the decision to use EMS (ie, age <65 versus ≥65 years, subsequent hospital admission, gender, employment status, and living with a significant other).^{4,5} The prepayment subscription status of each patient in the second Oregon community was obtained from local EMS billing records. Tax-based and subscription services were combined to create a binary variable (prepayment [yes, no]).

Because no measure of socioeconomic status was available in REACT baseline data, a process of address matching was used to classify each patient as a resident of either a high-income (median annual household income ≥\$30,000) or a low-income (median annual household income <\$30,000) census block group based on US census data.¹² Census block groups are the smallest geographic units for which detailed demographics are available from the US Census Bureau. Block groups in this study included from 250 to 476 housing units per group and demonstrated median annual household incomes ranging from \$6,145 to \$88,081.

Standard bivariate statistics were used to examine patient demographics. Multivariate logistic modeling was used to assess the influence of prepayment systems on EMS usage, controlling for covariates previously associated with EMS use (ie, age dichotomized as <65 and ≥65 years, gender, whether admitted, whether employed, and existence of a significant other).³⁻⁵ Multivariate analyses were performed on all residents, residents of high- and low-income census block groups, and those with and without private insurance. All of the covariates were entered into the logistic models in a single step (ie, a "forced entry" technique). The dichotomous measure identifying the presence of a prepayment system was then entered in a

second step.¹³ The appropriateness of resulting models was assessed using a Hosmer-Lemeshow goodness-of-fit statistic.¹⁴ All database management and statistical analyses were conducted using SPSS for Windows version 9.0.1 (SPSS Inc, Chicago, IL).

RESULTS

Of 1,086 patients presenting to participating EDs with chest discomfort, data regarding the mode of transport to the ED were available for 929 (85%). There were no meaningful differences with respect to demographic variables between patients with and without transport data. Ninety-three percent (860) of patients with transport data were successfully matched to a census block group. The remaining patients could not be matched because of missing or incomplete address data, or because addresses were in new construction areas. Unmatched patients did not differ in age, gender, admission status, employment status, level of EMS usage, or in the presence or absence of a payment system from those with matched addresses. Patients without mode of transport data or valid addresses were excluded from further analysis. The final study sample consisted of 860 patients, of whom 448 (52%) used the EMS system. Among those using EMS, 75% were subsequently admitted to the hospital compared with 25% who were released from the ED (Table 2).

The study sample was generally well insured (Table 3); 71.1% of patients had private insurance and only 5.9% of patients were completely uninsured. Residents of low-income census block groups were less likely to possess private insurance ($\chi^2[1]=7.05$, $P=.007$) compared with residents of high-income census block groups.

The logistic models reported below demonstrate a moderate to good fit of the data ($P=.338$ to $P=.832$), cor-

Table 1.
Demographic characteristics of the 4 Northwest REACT communities.

Site	Population	Area (sq mi)	Income (\$, median household)	Age (%)		Race/Ethnicity				
				30-54 y	55+ y	White	Black	Hispanic	Asian	Other
Oregon A	87,594	35.5	\$36,253	39.6	13.2	90.0	0.9	3.5	7.2	2.0
Oregon B	112,669	39.1	\$25,369	31.4	19.2	93.4	1.3	2.7	3.5	1.8
Washington A	126,647	33.7	\$36,258	37.9	24.1	86.0	2.2	2.7	9.8	1.9
Washington B	69,156	35.8	\$28,686	35.2	22.5	90.5	2.1	3.1	5.2	2.2
Mean for US 1990 census			\$29,943	33.9	20.9	81.3	12.5	10.0	3.5	1.8

A and B indicate blinded communities.

rectly classifying between 64% and 72% of all patients. All models included as covariates age, gender, admission status, employment status, and presence of a significant other in the household.

Findings based on the overall patient sample suggest that individuals older than 65 years and those who were subsequently admitted to the hospital are significantly more likely to activate the EMS system compared with younger patients and those released from the ED (Table 4). Prepayment systems for EMS were not found to significantly affect EMS usage in the overall patient sample. Other covariate factors not significantly associated with

EMS use included employment status, gender, or presence of a significant other.

When the patient sample was subdivided by residence in either a high ($\geq \$30,000$) or low ($< \$30,000$) annual income census block group (Table 5), both models continued to demonstrate that older age and hospital admission are significant predictors of EMS usage. The analysis also indicated that among patients residing in low-income census block groups, the presence of a prepayment system was associated with 2.6 times greater EMS use (95% confidence interval [CI] 1.41 to 4.79) compared with similar patients with no regional system (or

Table 2. Sample characteristics and EMS use (by hospital admission and release from the ED) for study communities.

Sample Characteristic	Oregon A	Oregon B	Washington A	Washington B
Patient age (y, mean \pm SD)	62 \pm 16	66 \pm 15	65 \pm 16	63 \pm 15
Sex (% female)	56 (51.9)	91 (48.1)	116 (56.0)	173 (48.6)
Has partner (% yes)*	68 (63.0)	112 (59.3)	115 (55.6)	215 (60.4)
Employed (% yes)	43 (39.8)	47 (24.9)	64 (30.9)	118 (33.1)
Median annual household income (\$)	34,908	28,725	35,313	31,387
EMS use (% yes)	62 (57.4)	75 (39.7)	117 (56.5)	194 (54.5)
Hospital admission (% yes) [†]	55 (88.7)	58 (77.3)	87 (74.4)	138 (71.1)
ED release (% yes)	7 (11.3)	17 (22.7)	30 (25.6)	56 (28.9)
EMS use (% no)	46 (42.6)	114 (60.3)	90 (43.5)	162 (45.5)
Hospital admission (% yes)	17 (37.0)	65 (57.0)	37 (41.1)	89 (54.9)
ED release (% yes)	29 (63.0)	49 (43.0)	53 (58.9)	73 (45.1)
Total no. of patients	108	189	207	356

A and B indicate blinded communities.

*Percentages based on the entire sample in each community.

[†]Percentages in subcategories based on the sample in the parent category.

Table 3. Insurance coverage by census block median annual household income.

Insurance Coverage	Low-Income (<\$30,000) No. (%)	High-Income (\geq \$30,000) No. (%)
Private non-health maintenance organization	144 (40.8)	270 (53.3)
Private health maintenance organization	92 (26.1)	111 (22.2)
Medicare without supplement	65 (18.4)	61 (11.9)
Uninsured	27 (7.6)	24 (4.7)
Medicaid/state insurance	15 (4.2)	24 (4.7)
Military insurance	6 (1.7)	8 (1.5)
Unknown	4 (1.2)	9 (1.7)
Total no. of patients	353	507

Table 4. Logistic regression modeling for factors associated with EMS use (all patients).

Variables	b*	Adjusted OR	95% CI
Age (\geq 65 y)	0.767	2.15	1.45–3.19
Admitted (yes)	0.964	2.62	1.88–3.65
Sex (male)	0.203	1.22	0.88–1.70
Employed (yes)	–0.262	0.76	0.50–1.16
Has partner (yes)	0.086	1.09	0.77–1.53
Prepayment system (yes)	0.403	1.49 [†]	0.98–2.18

*Estimated variable coefficients.

[†]Odds ratio adjusted for covariate factors by including the prepayment variable in a second step.

those failing to subscribe to a prepayment plan). A similar effect was not found among patients residing in high-income census block groups.

Among residents of low-income census block groups without private insurance (n=113), the presence of a prepayment program was associated with 3.87 times (95% CI 1.22 to 13.36) greater EMS use compared with similar patients with no such system available. Among those residing in low-income census block groups with private insurance (n=236), prepayment programs were also associated with greater EMS usage (adjusted odds ratio [OR] 2.38, 95% CI 1.15 to 4.94) when compared with similar patients without prepayment coverage. The only covariate measure remaining a consistent and significant predictor of EMS use in these analyses was admission status.

The presence of a prepayment subscription service in one Oregon study community makes it possible to compare EMS usage among residents with subscriptions (and those without) in the same community. Prepayment subscribers residing in low-income census block groups were 2.89 times more likely (95% CI 1.20 to 6.94) to activate the EMS system than low-income nonsubscribers. None of the other included covariates were significantly associated with EMS use (n=115).

Among residents of low-income block groups in all 4 communities who were subsequently admitted to the hospital (n=116), the presence of a prepayment mechanism significantly increased EMS use (adjusted OR 2.75, 95% CI 1.30 to 5.83) compared with those with no such mechanism. Prepayment was not significantly associated with increased EMS use, comparing patients with and without a prepayment mechanism, who were released from the ED (adjusted OR 2.11, 95% CI 0.73 to

6.04 [n=123]). No other covariates proved significant in either of these analyses.

DISCUSSION

Findings indicate that tax-based and hybrid EMS prepayment plans were not associated with EMS use among the overall sample of patients with acute chest discomfort. However, patients with chest pain who reside in lower-income census areas were 2.6 times more likely to use EMS if a prepayment system was available. Similarly, prepayment mechanisms increased EMS usage fourfold among residents of low-income census block groups without private insurance. These findings suggest that economic factors may affect the decision to use the EMS system among lower-income and underinsured patients with acute chest discomfort.

Additional research will be required to determine whether financial considerations affect EMS utilization under varying circumstances (eg, acute versus chronic conditions). In addition, future research may investigate the cost-effectiveness of prepayment plans in differing health care environments using a broader case definition.

There are several limitations in study design that qualify the findings of this study. The use of census block groups to assign individual patient household income infers an ecologic bias. In addition, household income may be a poor proxy for ability to pay for ambulance services. There are potentially confounding unmeasured community factors that may influence the decision to use EMS, such as differences in community structure (number of hospitals, population density) and differences in the medical care systems (penetration of managed care,

Table 5.

Logistic regression model of factors associated with EMS use (by high- and low-income census block groups).

Variables	Low-Income Group			High-Income Group		
	b*	Adjusted OR	95% CI	b*	Adjusted OR	95% CI
Age (≥65 y)	0.665	1.94	1.05–3.58	0.860	2.36	1.38–4.02
Admitted (yes)	1.090	2.97	1.75–5.04	0.886	2.42	1.57–3.74
Sex (male)	0.475	1.60	0.94–2.72	−0.012	0.98	0.64–1.51
Employed (yes)	−0.529	0.58	0.30–1.14	−0.093	0.91	0.52–1.58
Has partner (yes)	0.329	1.39	0.81–2.37	−0.086	0.91	0.57–1.45
Prepayment system (yes)	0.956	2.60†	1.41–4.79	0.005	1.00†	0.61–1.63

*Estimated variable coefficients.

†Odds ratio adjusted for covariate factors by including the prepayment variable in a second step.

public confidence in the EMS system, and so on). The community-matching process used in the REACT trial attempted to minimize some of these potential sources of bias. It is also possible that EMS that offer indemnity programs or are tax-based may promote EMS more aggressively than traditional fee-for-service programs. Notwithstanding this concern, an unpublished survey conducted in one of the Washington study communities indicated that only one third of resident seniors were aware that EMS usage was free of cost.

Finally, because this study is based on a chart review and not on patient surveys, we did not directly address issues of patient motivation in decisionmaking regarding EMS use. Previous survey research has shown that cardiac symptom severity, recognition of symptoms, and medical history of angina are all associated with increased EMS use.⁴ Future studies should incorporate case-specific financial measures to better assess the interplay between physiologic factors, environmental factors, and economic concerns in patient decisions surrounding EMS use.

The analysis based solely on patients in the second Oregon community provided a comparison of EMS use among those who did and did not participate in an EMS subscription prepayment service within the same community environment, thus mediating the confounding effect of unmeasured community factors. However, the interpretation of this data is limited by the self-selection of prepayment subscribers. It may be that those who chose to subscribe are more health conscious and therefore more likely to use EMS regardless of the influence of the prepayment system.

Finally, results associated with insurance status are less than straightforward. Because most study patients “without private insurance” were insured by federal or state sources, it is unclear why the presence of a prepayment system produced such a profound effect on EMS use among this population. Perhaps lower-income Medicare recipients are more likely to have experienced marginal costs from prior EMS use.

Prior research asserts that Medicaid recipients who lack financial liability for EMS use are more likely to request an ambulance transport that was considered “medically unnecessary.”¹⁵ Concern may be expressed that prepayment systems could augment overuse of EMS by low-income populations. Although it is questionable to equate admission status with “appropriateness” of EMS transport, our findings do indicate that among residents of low-income areas, prepayment was associated with significantly increased EMS use only in those subsequently admitted to the hospital.

In summary, despite potential limitations, this study documents that prepayment systems for EMS use, including publicly funded tax-based systems and optional subscription systems, may serve to increase the appropriate use of EMS among underinsured and low-income patients experiencing acute chest discomfort.

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